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Abstract. We have studied the quadrupole degree of freedom in a typical vibrational nucleus, ^{100}Ru. From inelastic neutron scattering at the Van de Graaff accelerator of the University of Kentucky, lifetimes of states in ^{100}Ru were determined. Absolute transition rates or limits thereon were extracted and compared to the theoretical description of this nucleus.

I INTRODUCTION

The nucleus ^{100}Ru was selected in a survey [1] searching for nuclei exhibiting the U(5) dynamical symmetry of the IBA model [2]. It has been shown recently [3] that for this isotope an admixture of SU(3) perturbation enhances the theoretical description of the two-phonon triplet, but definite conclusions could not be drawn because of the lack of knowledge of absolute transition rates of higher-lying states. We have attempted to address this question by measuring lifetimes using the Doppler-shift attenuation method (DSAM) after inelastic neutron scattering [4]. This (n,n$'\gamma$) experiment yielded the electromagnetic properties of the *three-phonon* part of the level scheme which we compare to those predicted by the theory. Details of the experiment will be published elsewhere [5].

II ^{100}Ru AS A VIBRATIONAL NUCLEUS

The hamiltonian relevant for the description of ^{100}Ru is a combination of the Casimir operators of the U(5) and SU(3) limits of the IBM-1 and is written explicitely as:

$$\hat{H} = \epsilon\hat{C}_1[U(5)] + \alpha\hat{C}_2[U(5)] + \beta\hat{C}_2[O(5)] + \kappa\hat{C}_2[SU(3)] + \gamma\hat{C}_2[O(3)] \tag{1}$$

Based on the level scheme of ^{100}Ru this nucleus was interpreted either as a pure vibrational nucleus, i.e. $\kappa = 0$, or as a slightly SU(3) perturbed vibrator with

$\kappa \neq 0$. Figure 1 illustrates the problems associated with both interpretations. The parameter κ was chosen to reproduce more accurately the electromagnetic properties of the levels up to the 2-phonon states whereas ϵ, α, β and γ were determined by a least-squares fit of the excitation energies (see ref. [3]). One notices that the excitation energies of the 1- and 2-phonon states is reproduced better in the perturbed calculation. Two extra levels lie in the 3-phonon energy region, the 2_4^+ state at 2099 keV and a 0^+ state which was not assigned to the same theoretical level for both calculations (see figure 1).

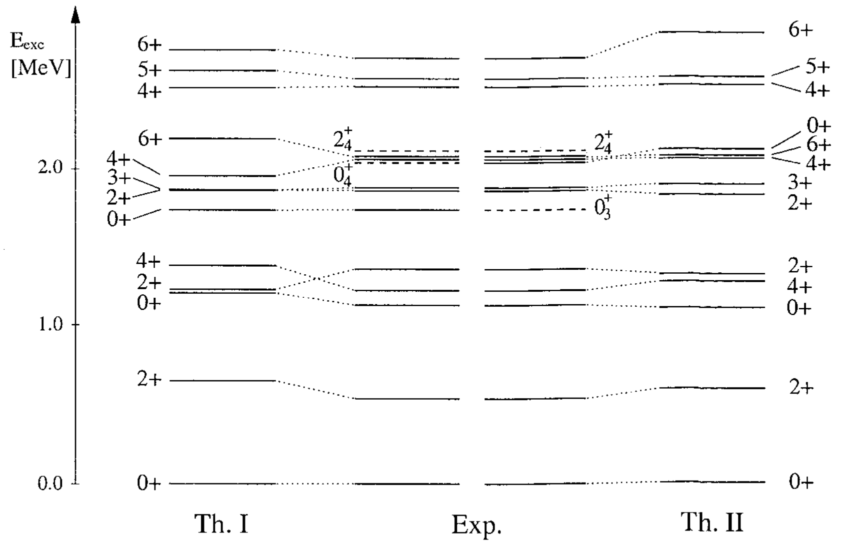

FIGURE 1. Comparison between experimental and theoretical excited states belonging to the normal configuration. The calculations were obtained in the pure (Th. I) and perturbed (Th. II) U(5) dynamical symmetry [3].

III RESULTS AND CONCLUSION

Table 1 lists the deduced absolute B(E2) values for the decay of the *three-phonon* states in ^{100}Ru obtained in this experiment. The absolute B(E2) strengths for the 3-phonon states are best reproduced in the perturbed calculation. The comparison of the experimental absolute B(E2) values with those given by the perturbed dynamical symmetry tends to indicate that the 0^+ of the normal configuration is the one at 2051 keV. In this framework, the 0_3^+ and 2_4^+ levels at 1741 keV and 2099 keV, respectively, could be members of an intruder band. The *three-phonon* states are also clearly of collective nature.

TABLE 1. Comparison of theoretical B(E2) strengths with the experimental values up to 3-phonon states in ^{100}Ru.

Transition		Absolute B(E2) [W.u.]			
$I_i^\pi - I_f^\pi$	E_γ [keV]	Exp.	U(5)	U(5)-SU(3)	
$2_1^+ - 0_1^+$	539.5	35.8(4)	35.8	35.8	$^{a,b})$
$0_2^+ - 2_1^+$	590.8	35(5)	60	45	$^{a})$
$4_1^+ - 2_1^+$	687.0	52(4)	60	58	$^{a})$
$2_2^+ - 0_1^+$	1362.2	1.9(4)	0	4.3	
$2_2^+ - 2_1^+$	822.6	30(6)	60	34	
$2_3^+ - 0_1^+$	1865.1	0.58(20)	0	0.05	
$2_3^+ - 0_2^+$	734.8	51(17)	33	20	
$2_3^+ - 2_1^+$	1325.6	3.1(12)	0	0.78	
$2_3^+ - 2_2^+$	502.9	23(11)	14	10	
$2_3^+ - 4_1^+$	638.6	17(6)	25	10	
$3_1^+ - 2_1^+$	1341.5	4.1(13)	0	5.2	
$3_1^+ - 2_2^+$	654.6	14(5)	51	36	
$3_1^+ - 4_1^+$	518.9	14^{+15}_{-10}	21	10	
$4_2^+ - 2_1^+$	1523.2	1.9(10)	0	3.1	
$4_2^+ - 2_2^+$	700.5	40(21)	38	31	
$4_2^+ - 4_1^+$	836.2	26(16)	34	16	
$0_4^+ - 2_1^+$	1512.1	2.4(1.3)	0	4.7	$^{c})$
$0_4^+ - 2_2^+$	689.5	16(8)	72	39	$^{c})$
$0_3^+ - 2_1^+$	1201.5	≤ 0.7			$^{d})$
$0_3^+ - 2_2^+$	378.8	≤ 160			$^{d})$

$^{a})$ Experimental values taken from ref. [6].
$^{b})$ Normalized to the experimental value.
$^{c})$ The 0_4^+ state is assigned here to the normal configuration in ^{100}Ru.
$^{d})$ The 0_3^+ state is assigned here to the intruder configuration in ^{100}Ru.

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